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SPECIFIC MUSCLE STRENGTH IS REDUCED IN FEMALE KNEES WITH INCIDCENCE RADIOGRAPHIC OSTEOARTHRITIS

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Purpose: Quadriceps strength plays an important role in knee biomechanics. Quadriceps weakness has been shown to be related to the onset of knee symptoms in women, but has not been associated with incident radiographic knee OA (KOA). However, previous studies have not examined muscle specific strength, a potentially more physiologically relevant measure of strength that accounts for the individual cross sectional area (CSA) of muscles. Here we explore whether specific strength differs between knees with incident radiographic KOA vs. non-incident controls.
Methods: Of 4796 Osteoarthritis Initiative participants, we studied knees that showed incident radiographic KOA (central readings, fixed flexion radiographs). These were defined as Kellgren and Lawrence grade (KLG) 0 or 1 knees at baseline, in which the combination of a definite osteophyte AND joint space loss (OARSI JSN>grade1) developed by 48 month follow up. These knees were matched by baseline KLG0/KLG1 frequency (~30%/70%) to control knees without incident KOA at 48M. Of 447 case and control knees, 342 had axial T1-weighted spinecho MRIs of the thigh AND maximal isometric strength measures of the extensors and flexors (Good Strength Chair, Metitur). To determine CSAs of the quads, hamstrings and adductors, we selected an MRI slice located at 30% femoral length (distal to proximal) based on an estimate derived from body height. Strength was normalized to weight (norm_strength=strength/weight). Muscle quality was evaluated by computing spec_strength (the primary analysis), and by the mean and standard deviation (SD) of the T1-weighted thigh muscle MRI signal intensity (as a proxy of fatty infiltration). Cases and controls were compared using conditional logistic regression.
Results: Of 179 knees with incident radiographic KOA, 113 were female (age 60.8, BMI 29.2) and 66 male (60.4; 29.4); of 195 non-incident knees, 113 were female (60.8, 27.0) and 82 male (59.4; 27.7). Quad spec_strength was found significantly (-12%) lower in incident vs. non-incident knees (Table 1). Quad strength (-7.1%) and norm_strength (-15%) were also significantly lower, quad CSA significantly greater (+6.5%), and the mean and SD quad MRI signal intensity greater (~5%, not significant) in incident vs. non-incident knees (Table 1). Similar relationships were observed in the flexors and adductors. In male knees, in contrast, the observed thigh muscle spec_strength was greater in incident than in non-incident knees, but the difference did not reach statistical significance.
Conclusion: In women (but not in men), incident radiographic KOA is found to be associated with lower muscle strength per unit CSA (spec_strength) and per unit weight (norm_strength). Obesity, which is independently associated with incident radiographic KOA in women, may be associated with fatty infiltration of thigh muscles, and may cause an unfavourable ratio between loading and muscular stabilization of the knee. Our findings suggest that important relations of muscle function and risk of radiographic KOA exist and are detected with physiologically relevant measures of strength (i.e. specific strength).

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SIGNIFICANT CHANGE OF BONE SHAPE OCCUR OVER THE FIRST FIVE YEARS AFTER ACL INJURY

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Purpose: An ACL tear is a common knee injury with an increased risk of developing knee OA in the longer term. The driving mechanisms behind this increased risk are not known but close monitoring of the early phase after injury may shed light on processes indicative of OA onset. In this study, we used a novel technique to monitor shape changes of bone occurring in the ACL injured knee over the first 5 years after injury. We explored changes during the first 2 years (BL→Y2), and during a subsequent three-year period (Y2→Y5) after an acute ACL tear.
Methods: 121 young (32 women, mean age 26.1 years) active adults with an acute ACL tear in a previously un-injured knee were included in a treatment RCT (the KANON-trial). Patients were randomized to either rehabilitation plus early ACL reconstruction (ACLR, n=62) or rehabilitation plus the option of having a delayed ACLR if needed (n=59). During the 5 year follow up period, 30 (51%) of those randomized to the latter group had a delayed ACLR. 111 participants had MR images available for BL and 2 year FUP; 108 had 2 and 5 year MR images available. Femur, tibia and patella bone surfaces were automatically segmented from the MR images using active appearance models1 (Imorphics, UK). Bone area regions were calculated from the segmentations for the medial and lateral femur, tibia and patella. MR images from the right knee of a group of 167 participants (younger than 49 years) with no signs of radiographic OA at baseline and at 2 years were identified from the Osteoarthritis Initiative and were used as a reference. Change was expressed in percent difference over time with positive values indicating increasing bone area and was compared using the paired T-test.
Results: For all regions of the knee and for both investigated time intervals, statistically significant changes of bone shape occurred with increased areas over time ($p \leq 0.002$). This change mainly occurred over the first 2 years after injury with the smallest increase in the lateral trochlea femur (mean increase 1%, 95% CI 0.7-1.2%) and the largest increase in medial femur (2.8%, 2.4-3.2%). Over the subsequent three year period smaller, albeit still significant, changes occurred with the smallest increase in bone area occurring in the lateral trochlea femur (0.4%, 0.1-0.6%) and the largest increase occurring in medial (1.4%, 0.9-1.9%) and lateral (1.4%, 0.9-1.9%) patella. The latter regions also showed the largest increase in bone area over the full 5 year period (4.1%, 3.2-4.9% respectively). The reference group without radiographic OA showed small or no significant change over a two year period (Table).
Conclusion: Our results show that the shape of all bones in the ACL injured knee joint undergoes rapid change during the first 2 years after an ACL tear. These changes could be measured as an increase of bone area and continue at a lower rate during the following three years after injury. Possibly, these changes are early measures of osteophyte formation but such relations, and the relation to treatment of the initial ACL injury, need to be further explored.

Quadriceps muscle status in incident and non-incident female knees

	Incident	Non-incident	Differences %	p	OR	OR 95%CI
	Mean±SD	Mean±SD				
Spec_strength [N/cm^2]	677±200	771±228	-12.2	0.003	0.998	0.997;0.999
Strength [N]	282±78.5	304±88.1	-7.11	0.07	0.997	0.994;1.00
Norm_strength [N/kg]	3.8±1.1	4.42±1.4	-14.7	0.0006	0.66	0.53;0.84
CSA [cm^2]	43.6±9.2	40.9±7.9	6.48	0.02	1.04	1.01;1.07
Mean MRI signal	437±92.8	419±91.4	4.39	0.13	1.002	0.999;1.01
SD MRI signal	142±29.8	135±27.1	5.24	0.07	1.01	0.999;1.02
OR= odds ratio	CI = confidence interval	N = Newton				